NUCLEAR PHYSICS

Low Temperature Electron Capture Beta-Decay

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The basic idea behind our experiment is that the probability of Electron Capture (EC) Beta Decay depends on the hyperfine state of the decaying isotope.[1-3] The total decay rate of a sample of an EC isotope would then depend on the populations of the hyperfine states and hence on temperature. The experiment requires placing radioactive sample crystals inside a scintillation detector, in the bore of a high field magnet, and cooling the apparatus to 20 mK using a dilution refrigerator. X-ray and gamma-ray emissions from the samples are used to monitor the EC process as the temperature and magnetic field are varied. Light from the scintillator is taken to a photomultiplier, at room temperature far from field center, using a fiberoptic bundle. During our experiments at NHMFL the detector was found to operate satisfactorily, with a reference source, at a temperature of 125 mK in a 15 T field. We were unable to cool the detector further, however, because of an unexpectedly large heat leak associated with the fiber bundle. This was a critical problem as the desired effect is expected to become pronounced below 100 mK. A series of supplementary experiments, performed with the assistance of NHMFL staff member Tim Murphy, has shown that the heat leak can be eliminated by using a fiber bundle containing fewer but larger diameter fibers. Continuation of the experiments is planned for next year.

References:

1 Folan, L.M., *et al*., Phys. Rev. Lett., 74, 499 (1995).
2 Folan, L.M., *et al*., Trans. Am. Nucl. Soc., 72, 103 (1995).
3 Folan, L.M., *et al*., J. Appl. Phys., 79, 5716 (1996).